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PHYMATOTRICHUM OMNIVORUM FOUND IN NEVADA

C. J. King

In a recent trip with Mr. R. H. Peebles, of the Division of Fruit and Vegetable Crops and Diseases, into the southeast corner of Nevada I made contact with the county agent of Clark County at Las Vegas and looked into some root rot trouble which had been causing crop losses to farmers in the Moapa and Virgin River Valleys for many years. As I expected from known infestations up the Virgin Valley in Utah the disease proved to be Texas root rot, caused by Phymatotrichum omnivorum. I can find no literature which reports this disease in Nevada although some of the early Mormon settlers in the Moapa Valley stated that they had sent specimens to Reno and to Washington for identification sixteen or more years ago. The fungus was found on alfalfa, and on recently dead apple trees and grape vines. (Division of Cotton and Other Fiber Crops and Diseases).

ROOT DISEASE OF SOME CONIFERS AND HARDWOODS CAUSED BY PHYTOPHTHORA CAMBIVORA (P. CINNAMOMI)

Bowen S. Crandall

During the past four years an intermittent survey has been made to determine the tree hosts and geographic distribution of the root parasite Phytophthora cambivora, or P. cinnamomi, which was combined with P. cambivora by Mehrlich 1/. A survey has been made in Middle Atlantic, Southern, Gulf, Midwestern, and Lake States. To date the fungus has been found in dying trees at places in the eastern half of Maryland, Virginia, Tennessee, Arkansas (probably extending into Oklahoma, Rich Mountain), Louisiana, Georgia, and South Carolina.

Within the known range of this fungus has been found a wide variety of broadleaf and coniferous hosts. It might be suspected from the following list that different hosts are affected in different regions, but cross-inoculations indicate that the difference is due to the presence or absence of certain hosts within a region or to incomplete information rather than to local host specialization of the fungus.

Hosts by States

MARYLAND: Pinus resinosa, P. sylvestris, Picea pungens, Larix (Japanese and European), Taxus (Japanese, English, and varieties), Juglans nigra, J. regia, Betula papyrifera, B. alba, Quercus borealis, Q. montana, Q. alba, Platanus orientalis, and Robinia pseudoacacia.

1/ Mehrlich, F. P. Pathogenicity and variation in Phytophthora species causing heart rot of pineapple plants. Phytopathology 26:23-43. 1936.

VIRGINIA: Taxus cuspidata and Picea excelsa.

SOUTH CAROLINA: Castanea dentata.

GEORGIA: Castanea dentata, C. mollissima, and Castanea hybrid "Paragon".

TENNESSEE: Castanea dentata.

LOUISIANA: Castanea mollissima and C. japonica.

ARKANSAS: Castanea ozarkensis.

Nursery stock, especially black walnut, which showed similar symptoms but from which P. cambivora was not isolated has been seen in Arkansas, Louisiana, Alabama, Tennessee, and Mississippi.

The prevalence of the disease in nurseries would indicate that it is probably already widespread in this country.

Symptoms

Except on Castanea spp., the fungus has usually been found causing a seedling and nursery disease. In a Maryland nursery it causes typical damping off of red pine in seed beds. Generally, however, it manifests itself as a root rot. On most of its hosts it causes a dry type of rot accompanied on coniferous hosts by resin deposition on and in the infected portions, including the wood. This infiltration of the wood at the point of first infection is particularly valuable as a distinctive symptom, since many fungi which kill bark and cause external resin flow in conifers do not cause resin deposit in the xylem. On black walnut and black locust it causes a soft rot often accompanied by disintegration of the lower portions of the tap roots. Near the soil surface and above the completely invaded regions local lesions frequently occur. These are often found to be connected through the deeper tissue.

Except in walnut where the infected tissue is black, areas invaded by the fungus are typically reddish brown in color. Very recently infected tissue is commonly characteristically mottled brown and light green with no definite margin.

The fungus normally advances from the totally invaded region into sound tissue in irregular wedge-shaped streaks. Although essentially a root parasite, it is often found in badly infected trees occupying a portion of the stem above ground with these wedge-shaped streaks. This is especially true on seedling oriental plane in which the narrow streaks

extend as much as a foot above ground and are accompanied by killing of cambium tissue with a consequent depressed area coinciding with the invaded tissue.

On conifers the first indication of the root trouble is the gradual loss of the normal green of the needles, with obvious wilting only if very young shoots are present. Usually on young broadleaf trees the first indication of the disease is a sudden wilting of the entire seedling. In oriental plane the leaves turn red prematurely.

Greenhouse inoculation tests have resulted in adding to the host list the important species Pseudotsuga taxifolia, which has been found highly susceptible to all isolates tested. Other inoculation results, which will be published later, will not be mentioned here.

Specimens and reports of this disease on forest and shade trees will be appreciated. (Division of Forest Pathology).

SUMMARY OF NINE YEARS' EXPERIENCE WITH RHODODENDRON WILT

R. P. White

This disease of juvenile rhododendrons, first brought to the attention of the New Jersey Agricultural Experiment Station prior to 1927, has been the subject of these notes from time to time for several years. On the basis of the outstanding symptom, which is a wilting of the foliage, followed by death, the disease has become generally known as "wilt". "Root rot" and "basal rot" are also generally used as symptomatic names, and on the western coast the name "stiff neck" is locally used to designate this disease. Since "basal rot" and "stiff neck" are more descriptive of two other diseases of rhododendron, it is suggested that this disease be designated as "rhododendron wilt and root rot".

The disease is primarily one of young stock. It has been observed on one-, two- and three-year-old seedlings of Rhododendron ponticum and on many Catawba hybrids, as well as one- and two-year-old grafted plants of most of the commercially produced hybrid varieties. Artificial inoculations have in addition proved the susceptibility of seedlings of the following species: R. carolinianum, R. maximum, R. catawbiense, R. californicum, and R. caucasicum var. Boule de Neige.

Rhododendron ponticum, and particularly the strain known as Hoogendijk, has proved the most susceptible of all species tested. R. maximum has never been observed naturally infected, and artificial inoculations are erratic on this species. In certain plantings of R. ponticum

a few plants have been observed which showed an apparent resistance. Such plants had several characteristics, such as reddish-brown stems and thicker, dark green, leathery leaves, by which they could be distinguished from the typical species. In beds of hybrid seedlings, certain individuals also have shown an apparent resistance.

The disease is the most important disease of seedling rhododendrons. The incidence of disease in nursery frames is from focal points, either a single diseased plant or a flat of diseased plants. From these original points, the organism spreads, resulting in an ever increasing diseased area, usually devoid of living plants, with plants in all stages of disease expression about the margin.

The individual plant exhibits well defined and characteristic symptoms. The first evidence of disease is a dull, yellowish-green color to the foliage, which soon after wilts permanently. The roots of such plants are more or less decayed and the base of the stem at the soil level and below is brown and decayed. By removing the cortex above this area, reddish-brown streaks can be observed extending up the stem in the cambium region. In cases where these streaks have reached the current season's growth, brown, sunken cankers are produced which are caused by the invasion of the cortical tissue.

The causal fungus of rhododendron wilt and root rot is Phytophthora cambivora. It has been referred to in previous notes and publications as Phytophthora cinnamomi but recently it has been determined that these two names are synonymous, and refer to one and the same fungus. This fungus has a wide distribution and extensive host range. It has been reported as causing diseases of cinnamon in the Dutch East Indies, of avocado in Puerto Rico and South Africa, of pineapple in the Hawaiian Islands and Australia, of chestnuts in Europe and the United States, of walnuts in Victoria, Australia, of Erica in New York, of a native fern in Hawaii, of red pine in the United States, of onion (by artificial inoculations), and of various other coniferous and deciduous trees in the nursery.

Due to this world-wide distribution and the ability of the fungus to attack such a variety of plants, it is likely that the disease on rhododendrons may exist in localities wherever they are grown commercially. It has not been observed, however, in native stands in the Pocono Mountains of Pennsylvania or in the region about Asheville, North Carolina. It was not observed in the nurseries of France, Holland or England in 1930, when an examination of many nurseries in these countries was made.

The incidence of disease in grafted stock is generally correlated with its severity in the ponticum understock upon which the named varieties were grafted. Certain cases, however, have been observed where such

an explanation does not seem to fit the facts obtainable.

The optimum growth conditions for the fungus have been determined to be a temperature between 25 deg. C. and 27.5 deg. C. (77 deg. F.-81.5 deg. F.) and at an acidity of pH 6.7-7.0. The rhododendron strains have been found to be severely restricted in growth at temperatures of 10 deg. C. (50 deg. F.) and below. All strains except one, which was isolated from chestnuts in England, were killed by long exposures to freezing temperatures, as occur in soils at 4 inch depths during the winter in the vicinity of New Brunswick, New Jersey.

No growth of the rhododendron isolate took place at acidities of pH 4.25 or lower.

Rhododendrons make the most rapid and extensive root systems in cool soils and it has been determined that R. ponticum grows best in soil acidities of pH 4.25 or in soils even more acid. Native R. maximum in New Jersey was found growing in soils as acid as pH 2.9 and with an average of pH 4.00. In other words, conditions of temperature and soil acidity which favor the growth of the rhododendron are distinctly limiting to the growth of the fungus which causes wilt and root rot.

Soil moisture has little influence upon infection of the roots with the causal organism, but it has a marked influence on the extension of the root system. Series of potted plants were kept at soil moistures of 30 to 90 percent of its capacity, and maximum growth of roots and tops took place in those pots held at 60 percent and 70 percent. These plants were then inoculated through the roots with Phytophthora cambivora and the first evidences of wilting appeared in plants growing in the higher soil moistures. Eventually, however, wilting and death of plants occurred at all soil moistures.

In commercial culture it is essential that rhododendrons be not overwatered. The fine fibrous roots are killed by lack of aeration in heavy or water-logged soils. This reduces the root system and offers excellent points of entry for the fungus. The older the plants, and consequently the more extensive the root system, the fewer the losses. The disease is rarely found in three- or four-year-old nursery stock which has become well established in a congenial soil environment.

Experiments with known infested soil, which was overwintered in the greenhouse and in an open frame in four inch pots plunged in the soil, have indicated rather conclusively that this fungus is killed when subjected to the temperatures normally reached in soil at a four inch depth at New Brunswick. Young R. ponticum seedlings were planted in these two lots of soil in the spring. After two and one-half months, the plants growing in the soil overwintered outdoors were healthy in appearance, with good

root systems. The duplicate lot of plants transplanted into soil overwintered in the greenhouse, which had never been frozen, were 89 percent dead and the foliage of the remaining 11 percent was showing a yellowish-green color, indicative of early symptoms. The root systems were completely decayed in most cases except on those plants still alive.

Due to these results and the appearance of the disease in the early summer from definite foci, it is considered unlikely that P. cambivora overwinters in fallow soils in New Jersey. Under the conditions of the cold house in winter, where undersized stock is carried over winter, the temperature is unfavorable for rapid invasion of tissues with the organism, and is favorable for continued root growth. As a result, potted plants may become pot-bound and appear perfectly healthy in the spring. Upon reaching the field, however, with the higher soil temperatures of the summer months, conditions become increasingly favorable for the fungus and correspondingly unfavorable for root action of the host.

A peak of losses is frequently reached two to three weeks following transplanting, indicating again that plants with injured or disturbed root systems are more liable to this disease than others. The absence of the disease in four-year-old plants in the nursery is further evidence of this fact.

On the basis of these facts, it becomes apparent that the commercial grower should endeavor to grow his understock for grafting purposes with the least possible number of transplantings. The delay in seed sowing until fall is a step in the right direction. He should continue to give seedlings and one year grafted plants partial shade and mulch in order to lower soil temperatures, in so far as possible, below the optimum for growth of the fungus. He should in most cases increase the acidity of the soil in frames and field, to pH 4.25 at least, and by so doing maintain an unfavorable growing condition for the fungus, but a most favorable acidity for Rhododendron ponticum. Grafted plants from the callousing frames should be removed from the pots and plunged in an acid mixture of leaf mold and soil. This enables the plant to establish an entire new root ball before going into the field. Rhododendrons grown from layers are less liable to this disease than grafted plants, partly because they are transplanted but once, and their root systems are not frequently disturbed and injured, and partly because they are not grafted.

Soil in frames should be allowed to remain fallow, roughly spaded up and unprotected during the winter months in order that freezing temperatures will penetrate as deeply as possible.

A very strict roguing in the frames during the growing season is absolutely essential, and further close sorting of plants should be done every time they are transplanted or handled in the grafting operations. (From New Jersey Agricultural Experiment Station, Department of Plant Pathology. Nursery Disease Notes (mimeogr.), 8:51-56. No. 12. June 1936.)

SIMULTANEOUS INFECTIONS OF STRAWBERRIES WITH CRINKLE AND YELLOWS (XANTHOSIS)

S. M. Zeller

Plants of the Corvallis variety of strawberry infected with yellows were secured near Aptos, California. In the greenhouse at Corvallis, Oregon, these plants developed typical symptoms of yellows. The symptoms in this variety were even more characteristic than in the Marshall variety.

Under central Californian conditions, crinkle-infected plants had been noticed finally to show symptoms of yellows. Some had believed this to indicate that the crinkly symptoms merely expressed early stages in the yellows disease. We attempted to prove whether this might be true.

Capitophorus fragaefolii was colonized on the yellows-infected Corvallis plants from Aptos for 14 days, after which third instars were transferred to crinkle-infected and healthy Marshall and Corvallis plants. Six instars were transferred to each plant as follows:

14	crinkle-infected	Corvallis plants
10	" "	Marshall "
11	healthy	Corvallis "
7	"	Marshall "

Of these the following began to show symptoms of yellows within 18 to 22 days:

12	crinkle-infected	Corvallis,	or 85.7	percent
7	" "	Marshall,	or 70.	"
7	healthy	Corvallis,	or 63.6	"
6	"	Marshall,	or 85.7	"

Simultaneously with the above experiment, 14 healthy plants each of Corvallis and Marshall were inoculated with crinkle in the same manner. Of these, 11 Corvallis plants and 7 Marshall plants showed crinkle infection in 17 to 20 days.

All of the infected plants were kept for about 20 months. In all cases where crinkle-infected had become subsequently infected with yellows, no leaves produced after those first showing any symptoms of yellows again had any symptoms of crinkle. In plants with crinkle alone, however, the crinkle persisted throughout the period of the experiment. In experimental plots at Corvallis, plants with crinkle have been growing for four years. The symptoms now (after four years) are typical of crinkle, with no symptoms similar to yellows. In fact crinkle is very common in field-run commercial stock of Corvallis and Marshall in western Oregon but symptoms similar to yellows are not found.

It is believed that the experiment reported here indicates the complete masking of crinkle symptoms by the virus producing yellows and that field observations and performance of the crinkle disease points to the conclusion that crinkle and yellows are quite distinct diseases. Whether double infection actually persists or crinkle attenuates after a plant is infected with yellows could perhaps only be proved should an insect vector for only one of the two viruses be discovered. Thus far we know but one vector, C. fragaefolii, for the two diseases. (Department of Botany and Plant Pathology, Oregon Agricultural Experiment Station).

A NEW DISEASE OF YOUNGBERRY IN OREGON

S. M. Zeller of the Oregon Agricultural Experiment Station sent in a specimen of youngberry (a hybrid dewberry) affected by stigma and anther blight caused by Haplosphaeria deformans Syd., collected in the lower Umpqua Valley in Douglas County, in June 1936. He remarks:

"This doubtless is the first report of this disease in the U. S. A. It has been reported from British Columbia (Dearness & Foster, Canadian Jour. Res. 9:43, 1933) and we often find it causing "dry berry" in loganberries in Oregon. The disease was very severe in certain localities this year."

A SOIL DEFICIENCY DISEASE CAUSING UNUSUAL DAMAGE TO CORN IN CENTRAL ILLINOIS

The following note was submitted by Benjamin Koehler of the Department of Agronomy, Illinois Agricultural Experiment Station:

Many cornfields in central Illinois suffered from an abnormal stunting and blighting of the plants. Reports came to the Agricultural Experiment Station beginning four days after the near-freezing temperatures of May 29 and 30. The plants were red to purple in color and the outer ends of many of the leaves had died. Contrary to the usual situation in cold injury, the most severe damage occurred on high ground, while corn in low places was normal. Reports and specimens were received from the following counties: Sangamon, Champaign, Christian, DeWitt, Fulton, Hancock, Iroquois, Kankakee, Knox, Logan, McDonough, Morgan, Peoria, Tazewell, Vermilion, Warren and Will. Some of the reported fields were visited. Studies of the plants and soil were made by Benjamin Koehler, Crop Pathologist, and E. E. DeTurk, soil Technologist, and other members of the Agronomy Department. It was found that in all affected fields the available phosphorus supply was low. The phosphorus supply is usually lowest on the highest parts of a field. No trouble of this kind occurred in fields well supplied with phosphorus. Isolations from the plants revealed no pathogenic organism that in themselves could be charged with such severe effects.

Potassium and phosphorus starvation are each known to be responsible for diseased conditions which have certain characteristics. Each causes a stunting and a dark discoloration of the interior of the lower end of the stalk. Potassium starvation causes a marginal firing of the leaves and blanching between the veins, while phosphorus starvation in early growth stages causes firing of the ends and a tendency toward formation of purplish color in the leaves. Plants thus stunted are easily invaded by a number of soil fungi which may increase the damage. Simple soil tests developed by R. H. Bray, Soil Analyst, were a great help in identifying the cause of the trouble.

In most fields where the phosphorus deficiency disease occurs this summer the corn had been preceded by a wheat crop. The relationship is not well understood, but it may be mentioned that straw returns comparatively little phosphorus to the soil. The acute situation found this year may be due to a combination of a low ebb in phosphorus availability caused by seasonal conditions, low temperatures, and subsequent low soil moisture that hindered recovery. (June 30).

DISEASES OF AUSTRIAN WINTER PEAS

J. L. Weimer

The work of J. H. Miller (Plant Disease Reporter 18:95-96, 1934) and of J. L. Seal (Alabama Agr. Esp. Sta. Rept. 1930, '31, '33, and '34) has shown that the Austrian Winter pea (Pisum arvense var.), when grown as a cover crop in Georgia and Alabama, is attacked by a number of diseases.

During the winter and spring of 1935-36, the writer made a survey of some of the most intensive Austrian Winter pea growing sections of Georgia, Alabama, and South Carolina in an attempt to supplement the information already available on the diseases of this crop.

The cold winter and spring tended to retard the development of the diseases early in the season. The cold wet spring was followed by a period of extreme drought during which most diseases made little headway. Owing to the unfavorable weather, the diseases for the most part were not as severe as in some previous years.

During the survey one or more fields in each locality visited were inspected. Specimens of diseased plants were pressed in the field and taken to the laboratory where isolations were made and the dried material studied.

Ascochyta pinodella and Mycosphaerella pinodes. These two fungi produce a typical blackening of the stem to which various common names

have been applied. The term "Black Stem" seems to the writer to be a very appropriate name for the symptoms produced by these organisms. These fungi are widespread and probably are the most destructive of any attacking the pea crop in the regions surveyed. It is difficult to determine which fungus is of greatest importance. The particular samples studied indicated that A. pinodella was from two to three times as abundant as M. pinodes in the blackened pea stems. Leaf spots were not very abundant but both fungi were isolated from the few spots studied, M. pinodes somewhat more frequently than A. pinodella. Five collections from three different points in South Carolina all gave A. pinodella. This organism was found exclusively in specimens sent to the writer by Dr. G. M. Armstrong from Ridge Spring, South Carolina. From the blackened stems of peas from central Alabama A. pinodella was isolated sixteen times and M. pinodes once. However, a study of dried material from the same source indicated a more equal distribution of the two fungi. Both fungi were isolated from affected peas early in December at Experiment, Georgia.

Ascochyta pisi. This fungus was not isolated from Austrian Winter peas at any time during the season. A very few spots were found on the leaves which may have been due to this organism but for the most part the plants were entirely free from infection by it, even in a plot where the leaves of other varieties of peas were quite badly spotted. This fact suggests that the Austrian Winter pea may be highly resistant to A. pisi, or it may mean that conditions were not suitable for infection. Miller (l.c.) found A. pisi attacking this crop late in the season of 1934. In 1936 it was too dry for infection to take place late in the season.

Septoria pisi. This fungus was found as early as November and was the most generally distributed of any of the fungi attacking peas. Often the blotch was the only disease found in a field or in a given locality. The disease seemed to be most prevalent and destructive in south central Georgia, but was present in South Carolina and Alabama also. Few plants were actually killed outright by this fungus but the total functional leaf area was reduced half or more in some fields.

Bacterium pisi. Miller (l.c.) states that the bacterial blight was the first disease to appear in 1934. Miller and the writer found blight at Athens, Georgia, on March 23, 1936. This was the first collection of this disease made by the writer for this year, although Miller had sent specimens from Athens to the writer on March 9, 1936. This disease was of little importance this year in localities visited. None was found in Alabama and only a small number of infected plants in South Carolina at Pontiac.

Erysiphe polygoni. Powdery mildew appeared at Tifton, Georgia, early in April and by May 7 most of the plants were heavily infected.

This disease did not appear at Experiment, Georgia, until about May 1. Powdery mildew seems to be of slight if any importance as a disease of Austrian Winter pea when used as a cover crop, but it might be a limiting factor in seed production.

Root rot. The organism causing this disease has not been definitely determined, but appears to be similar to Aphanomyces euteiches if not identical with it. This disease attacked nearly 100 percent of the plants in a plot in a pecan grove near Albany, Georgia. Pea seed from Oregon was planted between two rows of trees in the pecan grove in charge of J. P. Cole and J. R. Large of the U. S. Department of Agriculture Pecan Laboratory, Albany, Georgia. The remainder of the grove was planted to Hairy Vetch. The disease attacked both crops but affected the peas much more severely. The same disease was found at Americus, Georgia.

Peronospora pisi (DeB) Syd. This fungus was collected by Dr. Seal and the writer at Auburn, Alabama, on March 16, 1936, and was collected by the writer only a few times later in the season. At no time was it of economic importance. (Division of Forage Crops and Diseases).

DUTCH ELM DISEASE ERADICATION

During the period Dutch elm disease was found on one tree in Baltimore and on one in Norfolk. The number of confirmed and removed trees, as shown by weekly reports of the Bureau of Entomology and Plant Quarantine from May 31 to June 27, inclusive, are as follows:

	Connecticut	New Jersey	New York	Outside	Total
June 1 to June 27					
Trees confirmed	22	659	357	4	1,042
Trees removed	20	111	102	4	237
Total to June 27					
Trees confirmed	160	10,109	5,144	60	15,473
Trees removed	158	9,561	4,888	60	14,667

DROUGHTS IN THE UNITED STATES

J. B. Kincer

Droughts in the United States may be divided into two general classes. In one class are those of a transitory nature, affecting usually a relatively small area and of comparatively short duration, frequently lasting only a single year; in the other those general droughty conditions that have a tendency to persist for comparatively long periods. Smoothed weather records show long-time trends in precipitation, covering a good many years, alternately above and below normal. The short period droughts are not usually definitely related to these more general long-time trends. When a minimum phase of precipitation obtains, such as is now being experienced, there occur at short intervals what may be called families of droughts, in contradistinction to the transitory, or short period, ones that fall in the first group.

Prior to the minimum phase of precipitation responsible for the present family of droughts, so to speak, the last general condition of this kind occurred in the latter part of the 80's and the early 90's of the last century. At that time, following a series of years with rather abundant rainfall, widespread scanty moisture began in 1886, and, while interrupted in 1892 by fairly abundant moisture, there was a marked tendency generally for subnormal rainfall from 1886 up to 1895, culminating in severe droughts in 1894 and 1895, the driest years of that minimum phase. The year 1896 had fairly good precipitation, but 1897 was deficient in moisture between the Mississippi River and the Rocky Mountains.

Following this general long-time drought, there were several belonging to the transitory class -- short-lived and often affecting seriously only comparatively small areas. Among these may be mentioned that of 1901 in the interior valleys and the Southwest. The following year, 1902, had plenty of moisture in most States. Another transitory drought occurred in 1910, principally in the Central and Northern States and the South, but this again was largely a one-year affair. Another one in 1917 affected principally the Southwest and northern Plains, and still another, in 1925, was severe in the South and Southeast. Thus, for some 60 years up to 1930, there were a number of short-period droughts, but only one persistent and markedly dry phase of United States climate, that of 1886-1895, lasting, in general, about 10 years. Some years, of course, were better than others.

The present dry phase began in 1930 and has continued, with a few interspersions of fairly good years, such as 1935, up to the present time. There have been in this period three extremely dry years -- 1930, 1934, and 1936.

The few available precipitation records, covering 100 years or more, indicate that a general dry phase, somewhat comparable to that of 1886-95, and the more recent one of 1930 to date, obtained in the 30's of the last century, or approximately 100 years ago.

The outstanding wet phase of the United States climate in the last century was from about 1865 to 1885, with a secondary maximum during the first two decades of the present century, though several transitory droughts were interspersed. All of the foregoing statements refer specifically to that part of the country east of the Rocky Mountains.

Some tree ring records of the far Northwest indicate that there probably was a major minimum precipitation phase, at least in that area, soon after the middle of the 18th century, within the period 1755-80, with a succeeding maximum phase culminating about the beginning of the 19th century.

While study of long weather records has not as yet disclosed a law to justify a forecast of future droughts, such study does give an historical background, which warns us that droughts in future may be expected, just as severe as those of the past. For example, the records show that in the early nineties, or some 40 years ago, there was a drought in the so-called "dust bowl" just as severe as that recently experienced. Doubtless, when the present drought definitely comes to an end, there will be a period of years with comparatively heavy rainfall, just as before, and little will be heard about dust storms and the like. But, in planning a permanent farm program for such areas, the basic considerations should include the practical certainty that dry climatic phases, at least as severe as in the past, will recur. (U. S. Weather Bureau. From U. S. Department of Agriculture press release, July 13.)

FIRST HALF OF 1936 WAS DRY OVER MOST OF COUNTRY

Despite deep snows last winter and heavy rains early this spring in some parts of the country, the United States goes into the second half of 1936 with less than normal precipitation nearly everywhere, according to J. B. Kincer of the U. S. Weather Bureau.

Precipitation for the first six months of the year was especially short in the Ohio Valley, in the Great Lakes region, in the Mississippi Valley, and in the trans-Mississippi States. A large area, centering in western Arkansas, eastern Oklahoma, and southeastern Kansas, has had less than half normal rainfall, as has also a large area in the northern Great Plains. Only a few sections between the Appalachian and the Rocky Mountains have had as much as 75 percent normal rainfall since the beginning of 1936.

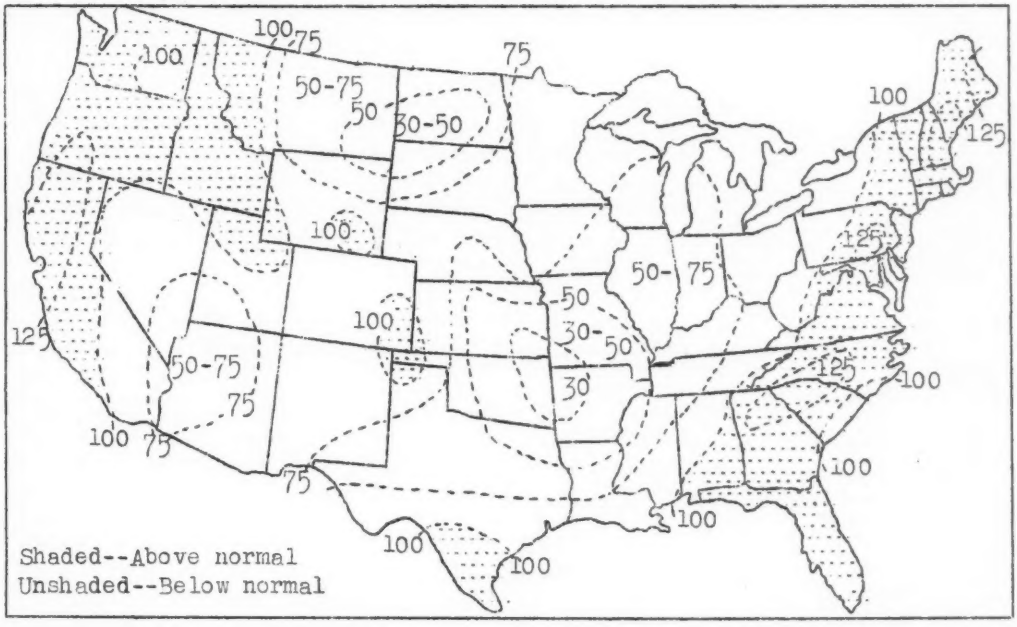

Figure 38. Moisture map for first half of 1936. (U. S. Weather Bureau). Figures show percentage of normal precipitation, Jan. 1 to July 1.

East of the Appalachians and west of the Rockies precipitation has been more nearly normal. Heavy spring rains, which brought disastrous floods, kept the 6-month precipitation in the Atlantic states well above normal. Precipitation has been more than normal also in most of the Far West and westward from western Montana and southeastern Idaho.

June was the driest of the six months in the interior of the country. Some places in Tennessee, northern Texas, and eastern Oklahoma had less than 10 percent of normal rainfall, and an area in the northern Plains had only about 15 percent. June brought much more than normal rainfall to the Far Northwest, to some central Rocky Mountain districts, and to south central Texas.

Following a dry May, the abnormally dry June spread serious drought over the principal agricultural sections of the country for the third time in six years. The need for rain at the end of June, Kincer says, was more widespread than it was in either 1930 or 1934 at that time of the year. In both 1930 and 1934 the greatest damage from drought occurred in July and August.

The first 3 days of July brought beneficial showers to heavy rains in most places from the Potomac, Ohio and lower Missouri rivers southward, but no material relief was reported for other drought sections.

Until the last week of the month June was generally cool. During that week, however, abnormally high temperatures prevailed in the Midwest and Northwest. The heat wave spread southeastward to the South Atlantic area. The highest temperatures reported by first-order Weather Bureau stations were 108 degrees at Huron, South Dakota, and at Concordia and Dodge City, Kansas, and 114 degrees at Phoenix, Arizona. (U. S. Department of Agriculture Press Release, July 3.)

PERCENTAGE OF NORMAL RAINFALL SINCE MAY 1

The accompanying map (Fig. 39) is taken from a press release of the U. S. Department of Agriculture. (The drought compared with previous years, July 11.) Comparison with Figure 38 brings out clearly the

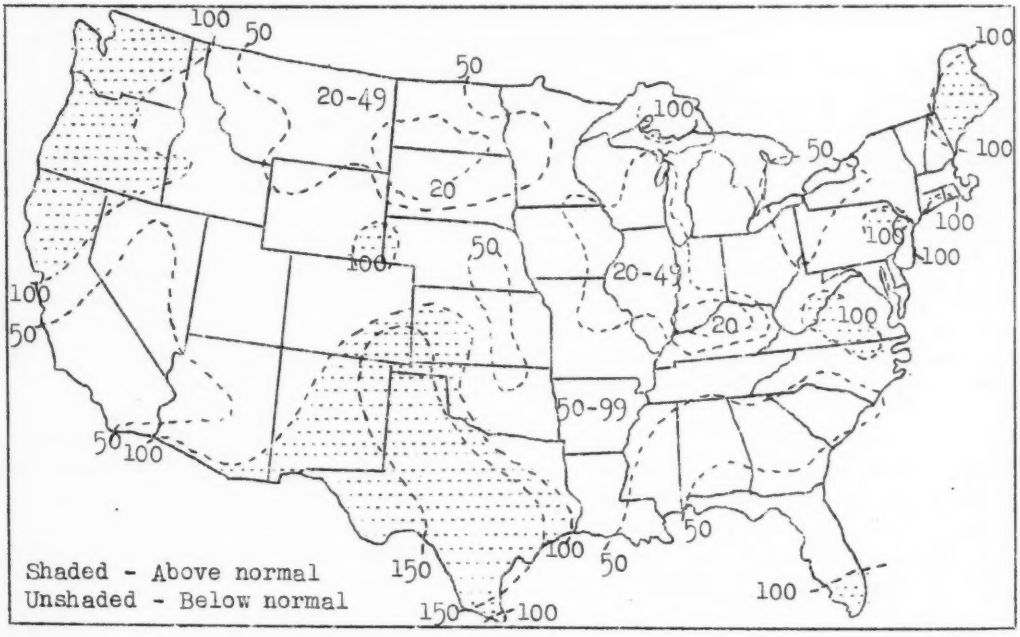

Figure 39. Percentage of Normal Rainfall, May 1 to July 10, 1936.

intensification and extension of the drought in certain areas, and its alleviation in others. The following discussion is also from the press release:

As shown by the accompanying map extreme drought conditions prevailed on July 1 chiefly in two large areas, one centering on the Dakota-Montana-Wyoming corner and the other on eastern Tennessee. In these worst areas all growing crops were seriously hurt, pastures were burned brown, water supplies were failing and some farmers were being forced to ship out livestock, according to reports received by the Crop Reporting Board of the Bureau of Agricultural Economics.

As in other years the border of the drought areas are constantly changing. Since July 1 the drought in the Northern Great Plains has become greatly itensified and has expanded to the eastward and southward, causing considerable further loss of early crops in nearby States, and endangering corn and other late crops over a wide area extending southward through Oklahoma and eastward into the Ohio Valley.

On the other hand heavy rains since July 1 broke the drought over a wide area extending from eastern Texas to eastern Tennessee. June rains went far to relieve drought conditions in the Carolinas and heavy May rains relieved the drought in the "dustbowl" area and the Southwest. While these rains have brought considerable relief, the map of precipitation as a percentage of normal shows that since May 1 the precipitation has been below normal over a large part of the country.